REMARKS

Reconsideration of the above-identified application in view of the amendments above and remarks below is respectfully requested.

Claims 1-164 are currently pending and are subject to a restriction requirement. Claims 39-61 and claims 71-164 have been cancelled herein with applicants reserving the right to file divisional applications.

Claims 1-38 and claims 62-70 have been elected are currently before the Examiner. Claims 2 and 7 have been cancelled, and claims 1, 3, 5, 6, 8-14, 29-31, 33, 34 and 36 have been amended herein.

Claims 2 and 7 stand objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim. The objection is respectfully traversed. In response, applicants have cancelled claims 2 and 7 and have amended claim 1 to state that the thermoplastic adhesive may be adhered to a portion of the bottom surface or to an available surface on the connecting substrate.

Claims 5, 6, 29-31, 33-34 and 36 stand objected to because of an informality. The objection is respectfully traversed. In response, applicants have amended the listed claims to recite proper Markush format as suggested by the Examiner.

Claims 1-38 and 62-70 stand rejected under 35 U.S.C. 112 as being indefinite as failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. The rejection is respectfully traversed.

Specifically, in line 1, lines 2-3, the phrase "solid or semi-solid" is stated to be vague and indefinite. In response, applicants state that the physical state of the material is solid or semi-solid. Additionally, for clarification, applicants have amended claim 1 to state that the thermoplastic adhesive is a solid or semi-solid at 55°C.

Specifically, in claim 3, line 2, the term "is" is stated to seemingly redefine the electronic device as a BGA only. In response, applicants have amended claim 3 to recite that the electronic device comprises a BGA.

Specifically, in claim 14, last line, the term "through" is said to be unclear as to its meaning. In response applicants state that through is meant to mean via and have amended claim 14 accordingly.

Claims 1-13, 16-19 and 62-70 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Schrock et al. (US 6,541,872). The rejection is respectfully traversed.

The Office Action States that Schrock is directed to a method of attaching a semiconductor to an organic substrate and that the die package comprises a die secured to a printed circuit board (PCB) with and adhesive tape and teaches the primary purpose of the semiconductor package is to provide a lead system for electrically and mechanically connecting the circuits on the die to a supporting substrate. The Office Action also states that in Schrock the adhesive tape can be a thermoplastic adhesive.

In response applicants state that Schrock is directed to the manufacture of a "surface mount electronic device" as referred to in the present claims. The present invention, and claim 1, is directed to attaching the already manufactured surface mount electronic device to a printed circuit board. In addition, applicants state that what is known in the art to manufacture the surface mount electronic device differs significantly for what is known in the art to attach a manufactured surface mount electronic device to a PCB. For example, in the manufacture of a surface mount electronic device, a thermoset or thermoplastic is selected to improve die package reliability by bridging the thermo-expansion differential between the materials comprising the integrated circuit (IC) and the printed circuit board therein. Thermoplastic adhesives are not utilized in the art to attach surface mount electronic devices to PCBs. Therefore, Schrock does not teach or

suggest the use of thermoplastic adhesives, as described by claim 1, to attach a surface mount electronic devises.

The present invention, and claim 1, is clearly directed to utilizing thermoplastic adhesives to adhere already manufactured surface mount devises and to mount those devices onto printed circuit boards. The present invention is an alternative to current under-fill technology which utilizes a thermoset resin to cover the entire bottom of the surface mount device. In contrast to the thermoset underfill, the thermoplastic adhesive of the present invention provides adhesion when applied only to a portion of the available surface and without risking damage to solder joints. The thermoplastic adhesive of the invention is formulated to have melt flow properties, now present in amended claim 1, which allow it to flow across the gap between the adhesive and the printed circuit board and make contact with the printed circuit board without run off, overflow or under-filling the surface mount electronic device.

The thermoplastic adhesive utilized in the present invention is advantageous in that it provides an increased resistance to hydrothermic cycling and/or mechanical impacts to the assembly when compared to known thermoset under-fills. In addition, the thermoplastic adhesive reduces the manufacturing time and allows for convenient reworking or repair of faulty chips.

Specifically, for claims 1-5 and 7, the Office Action states that although Schrock's teaching in mainly directed to form a semiconductor package with an organic substrate such as PCB, but that it would be obvious to one of ordinary skill in the art to attach as semiconductor package to any to any other PCB by applying a suitably thermoplastic adhesive tape to the bottom surface of the semiconductor package as well. In support of obviousness, the Office Action sites JP 08250835 (English Abstract) as teaching an LSI package having metallic bumps (i.e. a BGA) can be connected to a printed wiring board with an intermediate film like sheet of organic resin having a melting point and co-efficient of thermal expansion about the same as the metallic bumps.

In response, applicants state that as described above, the art for the manufacture of the surface mount electronic device differs significantly from the attachment of a surface mount electronic device to a PCB. Schrock is directed to the manufacture of a surface mount electronic device. JP 08250835 (JP '835) describes a film with perforations for the solder bumps of the device and requires a melting point and coefficient of thermal expansion (CTE) nearly equal to the solder for improved connection reliability. Like Schrock, JP '835 is directed to the manufacture of a surface mount electronic device. The present claim 1, differs from Schrock as described above, and additionally differs from JP '835 in that the thermoplastic adhesive does not have a CTE or a melting point nearly equal to the solder. Therefore JP '835 does not support obviousness.

For claim 6 the Office Action states that it is conventional that the PCB is made of a laminate of epoxy resin impregnated glass mat. In response, applicant states that claim 6 is dependent upon and incorporates the limitations of claim 1 and is therefore patentable for at least the same reasons as claim 1.

For claims 8-10, the Office Action states that Schrock lacks an express teaching of the various layouts, however, these would be well within the skill in the art. In support of obviousness, the Office Action sites Leander (US 2,510,120) as teaching adhesive strips in various shapes and forms. In response, applicant states that claims 8-10 are dependent upon and incorporate the limitations of claim 1 and are therefore patentable for at least the same reasons as claim 1.

For product by process claims 11-13, the Office Action states that absent the patentability of the result article, the limitation does not give patentable weight. In response, applicant states that claims 11-13 are dependent upon and incorporate the limitations of claim 1 and are therefore patentable for at least the same reasons as described above for claim 1.

For claims 14-15, the Office Action states that Schrock lacks an express teaching of using a layer of pressure sensitive adhesive having a small surface area to provide initial attachment, however it is believed this is well known in the art. As evidence of obviousness, the Office Action cites Hamerski (US 5,593,120) which teaches a layer of pressure sensitive adhesive over the initial attachment surface affords adhering the fastening structure by pressing then a layer of hot-melt adhesive can be heated so that upon cooling would cover the main attachment surface. In response, applicant states that claims 14-15 incorporate the limitations of claim 1 and are therefore patentable for at least the same reasons as claim 1.

For claims 16-19, the Office Action states that the amount of the thermoplastic adhesive layer, relative to solder bump height is either inherently disclosed by Schrock or an obvious optimization to one of ordinary skill in the art of hot melt adhesive and BGA packaging. As evidence of obviousness, the Office Action sites Gilleo et al. (US 5,638,176) which is directed to joining the electronic circuit components, and in Fig 8, shows a thinner adhesive film used to join a thicker conductive body between an electronic component and a PCB. In response, applicant states that claims 16-19 are incorporate the limitations of claim 1 and are therefore patentable for at least the same reasons as claim 1.

For claims 20-22, the Office Action states that Schrock lacks the express teaching of the complex viscosities of the thermoplastic adhesive at various temperatures, however, JP '835 teaches suitable hot melt adhesive has a melting point about the same as the metallic bumps. In response applicants state, that JP'835 requires a melting point and coefficient of thermal expansion (CTE) nearly equal to the solder for improved connection reliability. The present claim 1, differs from JP '835 in that the thermoplastic adhesive does not have a CTE or a melting point nearly equal to the solder.

For claims 62-69, the Office Action states that Schrock lacks the express teach on of the tensile properties of the thermoplastic adhesives, however, the scope of that invention of forming an adhesive bond between a semiconductor package with an organic

substrate is essential the same as claimed. In response, applicant states that claims 62-69 are incorporate the limitations of claim 1 and are therefore patentable for at least the same reasons as claim 1.

For claim 70, the Office Action states that Schrock's thermoplastic adhesive is inherently non-conducting. In response, applicants state that claim 70 is dependent upon and incorporates the limitations of claim 1 and is therefore patentable for at least the same reasons as claim 1.

Claims 23-38 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Schrock et al. (US 6,541,872) in view of Narushima et al. (US 6,426,138). The rejection is respectfully traversed.

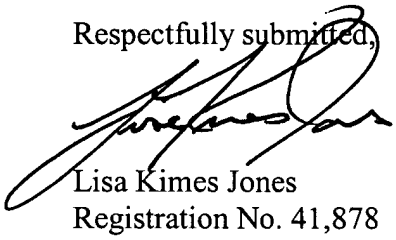
For claims 23-24, the Office Action states that Schrock lacks an express teaching of the composition of the thermoplastic adhesive, however, Narushima is directed to an adhesive film for BGA packaging which is either a thermosetting adhesive or a thermoplastic adhesive. The Office Action also states that Narushima lacks an express teaching of certain thermoplastic compositions such as derivatives of functionalized polyolefin adhesives and adhesive blends at various ratios, however it is noted that the reference teaches adhesives with a glass transition temperature (Tg) in the range of 30 - 180°C. Therefore, in the absence of unexpected results, the adhesive derivatives and blends are either inherently disclosed or an obvious selection.

In response, applicants state that Schrock, being directed to the manufacture of a surface mount device. As described above, in the manufacture of the surface mount electronic device, a thermoset or thermoplastic is selected to improve die package reliability by bridging the thermo-expansion differential between the materials. Schrock does not teach or suggest the use of a thermoplastic to attached the surface mount device to a PCB. Therefore, Narushima does not solve the deficiency of Schrock and the combination does not teach or suggest the present invention.

For claim 35, the Office Action states that, in the absence of unexpected results, it is believed the density of the functionalized polyolefin claimed is inherent in the material property. In response applicants state that claim 35 incorporates the limitations of claim 23, which incorporates the limitations of claim 1 and is patentable for at least the same reasons as claims 1 or 23.

In light of the above amendments and remarks, it is respectfully submitted that the pending claims of the present application are in condition for allowance. If the Examiner has any questions or requires additional information, he is invited to contact the undersigned.

Respectfully submitted,



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